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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : F02M 29/04, 7/22	A1	(11) International Publication Number: WO 00/01940
		(43) International Publication Date: 13 January 2000 (13.01.00)

(21) International Application Number: PCT/IB99/01214

(22) International Filing Date: 28 June 1999 (28.06.99)

(30) Priority Data:
9814100.5 1 July 1998 (01.07.98) GB

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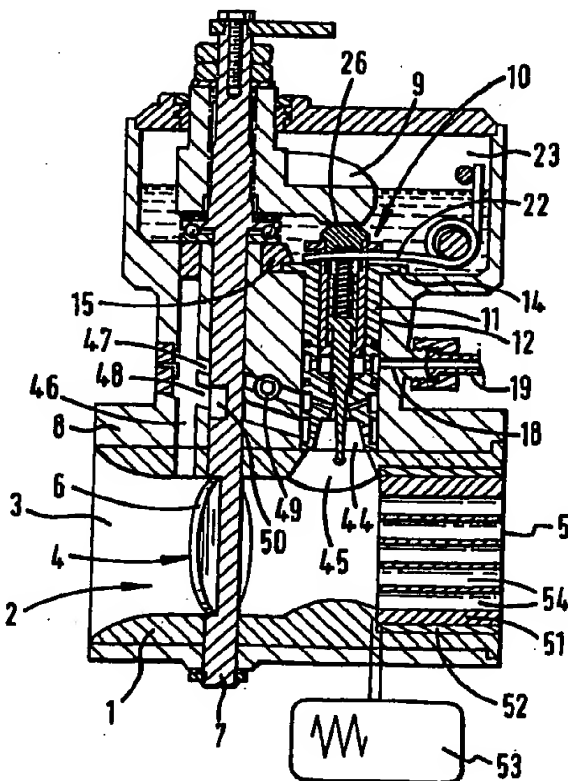
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: FUEL-AIR MIXTURE APPARATUS

(57) Abstract

In a fuel-air mixture device, downstream of a throttle (10) and a fuel introduction device, a block (51) is provided across the primary air passage (2). The block has a plurality of passageways (54) through it for air flow towards an inlet manifold. These improve mixture of the fuel and air.



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FUEL-AIR MIXTURE APPARATUSBackground of the Invention

The present invention relates to a fuel-air mixture apparatus, particularly for
5 an internal combustion engine.

Fuel-air mixture apparatuses of the type where fuel is mixed with air prior to
induction into the cylinder(s) of an engine generally rely on a pressure reduction at a
throttle in the device to draw fuel into the device, in which case the device is known
10 as a carburettor, or rely on fuel injection into the air as it passes through the device.

Generally, the prior devices rely on a single stage of mixture of fuel and air
and are limited as regards the droplet size and total vaporisation of the fuel in the air
which they induce. Inadequate vaporisation and too large a droplet size result in
15 unburned and/or incompletely burnt fuel being present in the exhaust from the engine.

In my International Application No WO 97/48897, I have described and
claimed an invention which I refer to below as "My Earlier Invention" and which
comprises a fuel-air mixture apparatus having:

- 20 • a primary air passage having an inlet, an adjustable throttle and an outlet,
- a secondary air passage having an inlet and an outlet to the primary air passage
between its adjustable throttle and its outlet,
- a variable orifice nozzle for introducing fuel into the secondary air passage,
the nozzle having a mouth and a down-stream pointing tapered needle in the
25 mouth to provide variability of the orifice by axial movement of the needle
and
- a linkage or control device for linking or controlling the position of the needle
to the position of the adjustable throttle in the primary air passage for
adjustment of the orifice of the nozzle,
- 30 the arrangement being such that in use the fuel mixes with the air flowing through the
secondary air passage prior to mixing with the air flowing in the primary air passage.
and the fuel flow from the nozzle is matched to the position of the adjustable throttle.

CONFIRMATION COPY

The Invention

The object of the present invention is to a further improved fuel air mixture apparatus.

5 The invention is based on passing a fuel-air mixture through an apertured vaporisation block in the apparatus to enhance the degree of mixing of the fuel with the air.

10 According to my present invention, there is provided a fuel-air mixture device comprising:

- a primary air passage having an inlet, an adjustable throttle and an outlet,
- a variable orifice nozzle for introducing fuel to the primary air passage, the nozzle having a mouth and a tapered needle in the mouth to provide variability of the orifice by axial movement of the needle, the needle being arranged
15 transversely of the primary air passage and
- a linkage or control device for linking or controlling the position of the needle to the position of the adjustable throttle in the primary air passage for adjustment of the orifice of the nozzle and
- an apertured vaporisation block having a plurality of air passageways through
20 the block, which subdivide a portion of the primary air passage between the fuel introduction position and the outlet.

25 The apertured vaporisation block may be integral with a member defining the primary air passage. Alternatively it may be fitted to the latter. In this case, the apertured vaporisation block may be mounted in such manner as to be ultrasonically excitable. Typically this can be by mounting the block in an ultrasonically excitable ring. Alternatively, the passageways in the block can be lined by ultrasonically excitable tubes.

30 The apertured vaporisation block can be a solid block in which the air passageways are formed by machining or casting. Alternatively, the apertured vaporisation block can be laid up from a plurality of layers, preferably by winding, the layers having regular formations extending out from each layer to space it from the

next layer. The formations at each layer can be continuous with the formations at the next or inter-spaced with the formations at the next.

5 In one preferred embodiment, the apertured vaporisation block is provided wholly downstream of the position of the fuel introduction means, preferably with an upstream face of the apertured vaporisation block being formed concavely, preferably conically.

10 In another preferred embodiment, the apertured vaporisation block is provided at and extending downstream of the position of the fuel introduction means.

Whilst I envisage the contrary, I prefer that the present fuel-air mixture apparatus should be fully in accordance with My Earlier Invention, that is to say incorporating:

- 15 • a secondary air passage having an inlet and an outlet to the primary air passage between its adjustable throttle and its outlet,
- the arrangement being such that in use the fuel mixes with the air flowing through the secondary air passage prior to mixing with the air flowing in the primary air passage and the fuel flow from the nozzle is matched to the position of the adjustable throttle.

20

In the embodiment wherein the apertured vaporisation block is provided at and extending downstream of the position of the fuel introduction means, the apertured vaporisation block has at least one transverse bore leading from the secondary air passage to a respective one of the air passageways through the block. Each of the passageways can have a transverse bore leading from the secondary air passage.

25 Alternatively, some of the air passageways may not be in communication with the secondary air passage and not receiving fuel-air mixture in use. Some of the air passageways may be in communication with the secondary air passage only via others of them.

30

The fuel introduction needle may extend into one or more of the air passageways in the apertured vaporisation block.

It is envisaged that the passageway(s) having the transverse bore(s) can be configured as venturi(s) with the narrowest throat(s) being at the orifice(s) of the transverse bore.

5 To aid mixture of the fuel with the air in the passageways, the latter can have turbulence inducing formations downstream of the transverse bore.

To help understanding of the invention, a specific embodiment thereof will now be described by way of example and with reference to the accompanying
10 drawing, in which:

Figure 1 is a cross-sectional side view of a fuel-air mixture apparatus of the invention;

Figure 2 is a scrap cross-sectional view on a larger scale of the needle actuator in the apparatus of Figure 1 with the needle in its closed position;

15 Figure 3 is a similar view of the actuator with the needle in its open position;

Figure 4 is a similar view of an alternative air passageway block;

Figure 5 is a view similar to Figure 1 of an alternative apparatus of the invention;

Figure 6 is a cross-sectional end view of the air passageway block in the
20 apparatus of Figure 5;

Figure 7 is an end and perspective view of another alternative air passageway block; and

Figure 8 is a similar pairs of views of yet another air passageway block.

25 The fuel-air mixture device shown in Figure 1 is a carburettor. It has an air passage member 1 defining a primary air passage 2 with an inlet 3, an adjustable throttle 4 and an outlet 5. The inlet will be connected in use to an air cleaner (not shown), the outlet will be connected to an engine manifold (not shown) and the throttle will be connected to a throttle control (also not shown). The throttle has a
30 vane 6 carried on a shaft 7 journaled in a body 8 – into which the air passage member 1 is fitted - and having at one end a cam plate 9 against which a needle actuator 10 bears.

Referring additionally to Figures 2 & 3, the needle actuator is slidingly accommodated in a needle carrier 11 fitted into a bore 12 in the body 8 and sealed there by a pair of O-rings 13. The needle carrier is retained by a flange 14 against which a block 15 acts, the block being held in place by the throttle shaft 7. Between the O-rings 13, the needle carrier has a circumferential groove 16, which opens to the interior 17 of the needle carrier 11. A fuel supply duct 18 in the body communicates with a fuel supply line 19 and the groove 16. The interior of the needle carrier is defined by a bore 20 in which the needle actuator 10 is accommodated in a fuel tight manner, with a seal 21 in a groove at the bottom end of the actuator. A spring 22 in a lubricant chamber 23 acts beneath a flange 24 on the needle actuator and urges the latter via an end dome 25 against a rotary cam surface 26 of the cam plate 9. A needle 27 is carried axially of the needle carrier in a bore 28 in the needle actuator 10. The needle has a head 29 accommodated in the actuator. A spring 30 captivated by the dome 25 urges the needle 27 towards the primary air passage 2. A seal 31 on the needle seals it to its actuator 10. A shank 32 of the needle extends from the actuator and has at its opposite end a groove carrying an O-ring 33 and a steep taper 34, which can seat in an internal orifice 35 in the needle carrier 11, with the O-ring 33 seating just outside the orifice (see Figure 2), when the needle actuator is displaced so far by the cam as to cause the head 29 and/or the seal 31 to lift from an abutment 36 in the carrier on which it normally engages, as shown in Figure 2.

In the normal operating position of the cam plate 9, as shown in Figure 3, with the needle actuator lifted by the spring 22, the needle head 29, seal 31 and abutment 36 are held together and the taper 34 is drawn clear of the orifice 35. The needle has a finely tapered needle proper 37 extending on through the orifice from the thin end of the steep taper, for varying the extent to which the orifice is open to the passage of fuel in accordance with the longitudinal position of the needle. This position is directly linked to the position of the throttle by the cam.

The needle terminates in a "pip" 38, which encourages any fuel running along its fine taper to shed as a fine droplets.

Beyond the orifice 35 of the needle carrier 11, it has an extension 39 having two external grooves 40, 41, from which lead bores 42, 43 to an outwardly tapering

mouth 44 of the carrier. This is in register with a similarly tapering opening 45 in the air passage member 1, opening into the primary air passage 2.

5 A secondary air passage 46 leads from the primary air passage 2 upstream of the throttle 4. The passage 46 branches into two 47,48. The smaller 47 of these leads via a slow running, secondary air flow adjustment 49 to the upper groove 40, whose bores 42 open to the narrow end of the tapered mouth 44. The larger secondary air branch 48 intercepts the bore 49 in which the throttle shaft 7 is journaled. At the interception, the shaft has a flat 50, which aligns with the branch when the throttle is open, but closes the branch when the throttle is closed for slow running, whereby the
10 secondary air all passes via the other branch. The larger branches opens into the groove 41, via which its air passes on to the bores 43 and into the mouth 44 for mixing with the fuel metered by the needle.

15 Down-stream of the mouth 44, a block 51 is provided across the primary air passage 2. It is mounted in a ring 52 of piezoelectric material provided with an excitation circuit 53. The block has a plurality of passageways 54 through it for air flow towards the inlet manifold. These increase the turbulence in the air flow and increase the surface area on which fuel can deposit as fine droplets during the periods
20 of stagnation corresponding to compression, ignition and exhaust for a single cylinder engine.

In operation of the carburettor, the throttle is opened. This allows the needle to move back from its position closing the orifice 34. Fuel, generally petrol, is
25 allowed to flow at a rate appropriate to the throttle opening. It enters the mouth 44 and mixes with the secondary air flow. This air and the fuel, which represent a rich and non-homogeneous mixture, flows on to the primary air passage. Here mixture of the fuel and air reaches the desired composition. On entering the passageways 54, the homogeneity is improved by turbulence in the passageways and by the provision of a
30 large surface area on which fuel can deposit during stagnation and be (re-)evaporated during air flow. Further turbulence occurs on exit from the passageways.

Figure 4 shows an alternative construction of the block 51', in which the ring 52 is dispensed with and replaced by a series of piezoelectric tubes 55, which are all excitable. This block also has a conically, concave upstream face 56, which encourages laminar flow in the tubes 55. In a further, simpler alternative, the piezoelectric elements can be dispensed with as in the following embodiment.

Turning now to Figures 5 & 6, the carburettor there shown is essentially similar to that of Figures 1, 2 & 3, except that the block 151 is positioned to receive the secondary air flow directly into its passageways 154. In place of the mouth 44, the air passage member 101 has a V-slot 144 cut in it, to spread partially around the block. The block has a number of bores 160 opening from the slot 144 to convey the flow of secondary air and fuel to some of the passageways 1541. Others 1542 do not receive secondary airflow. The fuel is mixed with air flowing in these downstream of the block 151 due to turbulence in the air streams leaving the passageways.

15

A number of variants can be envisaged. The needle may extend into one of the radial bores aligned with the needle. As shown the passageways 154 are parallel bores. At least those 1541 into which the radial bores lead may be formed with venturis at the junction with these bores to encourage the secondary air flow into them. Further downstream of the bores, the passageways may be provided with surface roughness to promote turbulent air flow and mixture of the fuel and air flowing in them.

Whilst the apertured vaporisation blocks 51, 51', 151 are solid blocks in which the passageways are formed by machining or casting, the alternatives 251, 351 shown in Figures 6 & 7 formed of a plurality of layers 2511, 3511. These are of sheet metal and spirally wound. The layers 2511 have a series of spacers 2512, which are two thicknesses of the sheet metal abutted and adhered together to form the spacers with a height equal to the spacing of the layers. The spacers are aligned to give structure rigidity. The layers 3511 have similar spacers 3512, but which are not abutted, and meet the next layer at peaks 3513, which are adhered to the next layer. The spacers can be angled with respect to the direction of their spiral winding, to give airflow

30

through the block a vortex flow. As an alternative to the spacers being wound, they could be cast or moulded.

The invention is not intended to be restricted to the details of the above
5 described embodiment. Various alternatives have been identified in the description
above just before the description of the drawing. In addition, the passageways may be
provided in a variety of sizes. As in my earlier invention, the direct mechanical
linkage between the position of the needle and the position of the throttle can be
replaced by electronic control.

10

Claims

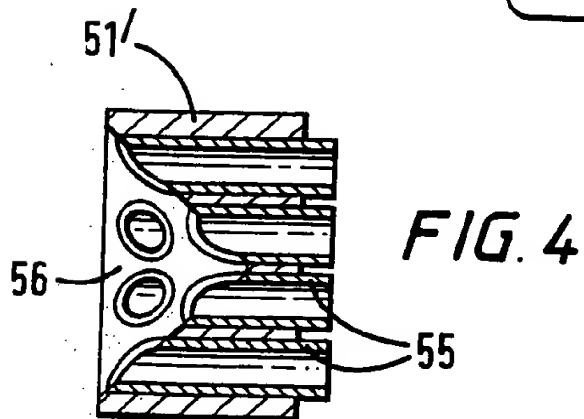
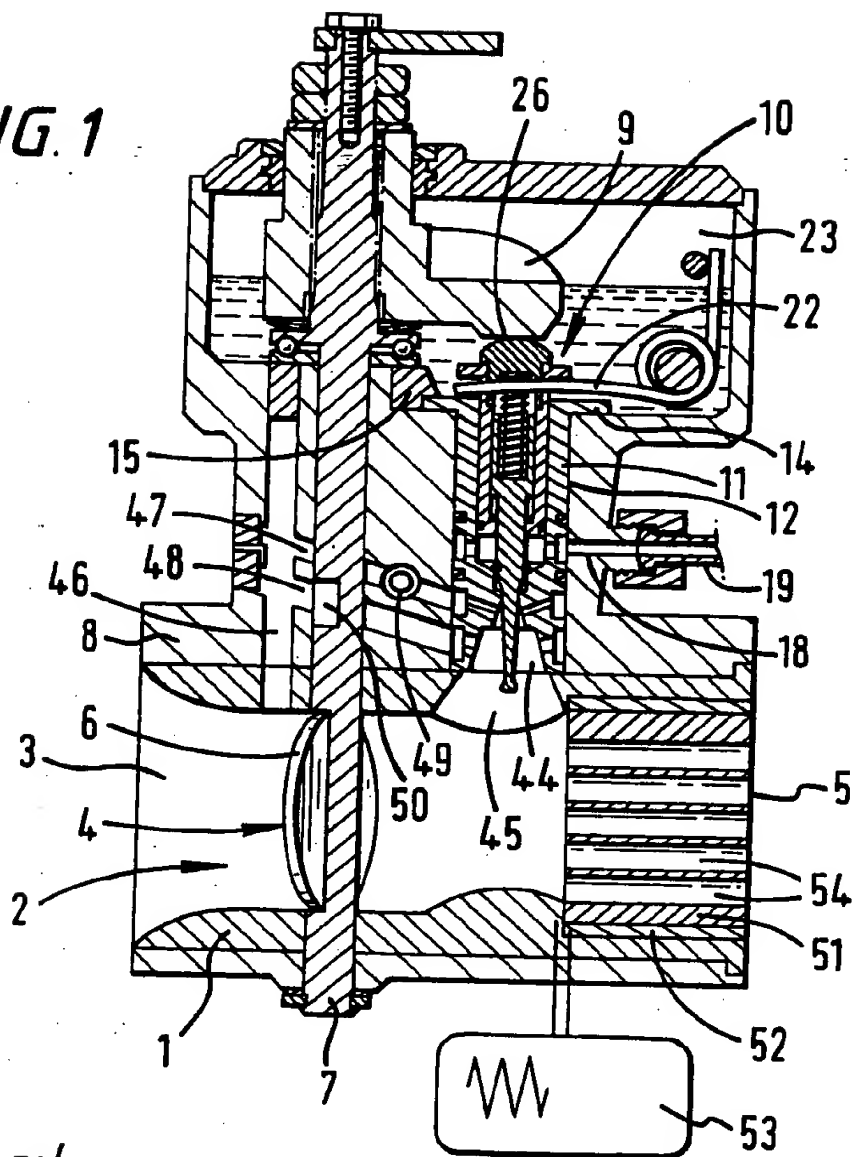
1. A fuel-air mixture device comprising:
 - a primary air passage having an inlet, an adjustable throttle and an outlet,
 - a variable orifice nozzle for introducing fuel to the primary air passage, the
5 nozzle having a mouth and a tapered needle in the mouth to provide variability of the orifice by axial movement of the needle, the needle being arranged transversely of the primary air passage and
 - a linkage or control device for linking or controlling the position of the needle to the position of the adjustable throttle in the primary air passage for
10 adjustment of the orifice of the nozzle and
 - an apertured vaporisation block having a plurality of air passageways through the block, which subdivide a portion of the primary air passage between the fuel introduction position and the outlet.
2. A fuel-air mixture device as claimed in claim 1, wherein the apertured
15 vaporisation block is integral with a member defining the primary air passage.
3. A fuel-air mixture device as claimed in claim 1, wherein the apertured vaporisation block is a member fitted to the primary air passage.
4. A fuel-air mixture device as claimed in claim 3, wherein the apertured vaporisation block is mounted in such manner as to be ultrasonically excitable.
- 20 5. A fuel-air mixture device as claimed in claim 4, wherein the apertured vaporisation block is mounted in an ultrasonically excitable ring.
6. A fuel-air mixture device as claimed in claim 4, wherein the passageways in the block are lined by ultrasonically excitable tubes.
7. A fuel-air mixture device as claimed in any preceding claim, wherein the
25 apertured vaporisation block is a solid block in which the air passageways are formed by machining or casting.
8. A fuel-air mixture device as claimed in any one of claims 1 to 6, wherein the apertured vaporisation block is laid up from a plurality of layers, preferably by winding, the layers having regular formations extending out from each layer to space
30 it from the next layer.
9. A fuel-air mixture device as claimed in claim 8, wherein the formations at each layer are continuous with the formations at the next.

10. A fuel-air mixture device as claimed in claim 8, wherein the formations at each layer are inter-spaced with the formations at the next.
11. A fuel-air mixture device as claimed in any preceding claim, wherein the apertured vaporisation block is provided wholly downstream of the position of the fuel introduction means.
12. A fuel-air mixture device as claimed in claim 11, wherein an upstream face of the apertured vaporisation block is concavely formed, preferably conically.
13. A fuel-air mixture device as claimed in any one claims 1 to 10, wherein the apertured vaporisation block is provided at and extending downstream of the position of the variable orifice nozzle.
14. A fuel-air mixture device as claimed in any preceding claim, including:
- a secondary air passage having an inlet and an outlet to the primary air passage between its adjustable throttle and its outlet,
- the arrangement being such that in use the fuel mixes with the air flowing through the secondary air passage prior to mixing with the air flowing in the primary air passage and the fuel flow from the nozzle is matched to the position of the adjustable throttle.
15. A fuel-air mixture device as claimed in claim 14, wherein the apertured vaporisation block has at least one transverse bore leading from the secondary air passage to a respective one of the air passageways through the block.
16. A fuel-air mixture device as claimed in claim 15, wherein each of the passageways has a transverse bore leading from the secondary air passage.
17. A fuel-air mixture device as claimed in claim 15, wherein some of the air passageways are not in communication with the secondary air passage, whereby they do not receive fuel-air mixture in use.
18. A fuel-air mixture device as claimed in claim 15, claim 16 or claim 17, wherein some of the air passageways are in communication with the secondary air passage only via others of them.
19. A fuel-air mixture device as claimed in any one of claims 14 to 18, wherein the fuel introduction needle extends into one or more of the air passageways in the apertured vaporisation block.
20. A fuel-air mixture device as claimed in any one of claims 15 to 19, wherein the passageway(s) having the transverse bore(s) are configured as venturi(s) with the narrowest throat(s) being at the orifice(s) of the transverse bore.

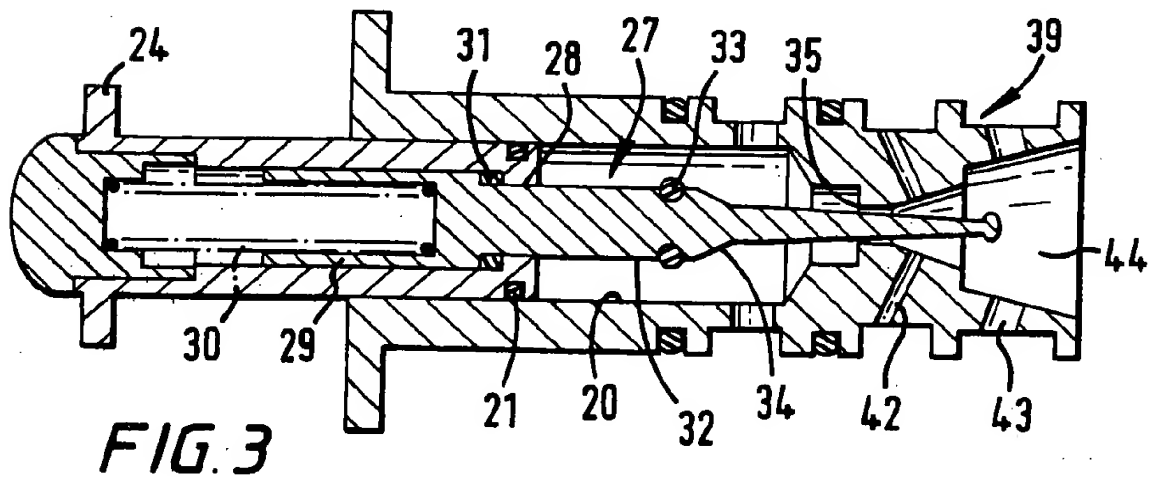
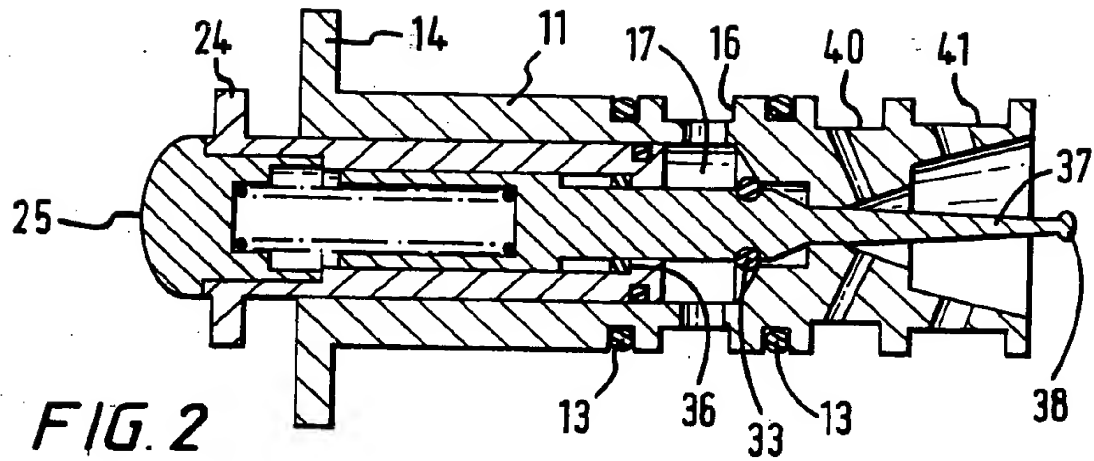
21. A fuel-air mixture device as claimed in any one of claims 15 to 20, wherein the passageway(s) have turbulence inducing formations downstream of the transverse bore(s), to aid mixture of the fuel with the air in the passageways.
22. A fuel-air mixture device as claimed in any preceding claim, including:
- 5 • a shaft on which the throttle is carried,
- a cam plate carried on a shaft and
- an actuator for the tapered needle bearing against the cam plate.
23. A fuel-air mixture device as claimed in claim 22, wherein the needle actuator is accommodated in a fuel tight manner in a needle carrier and extends into a lubricant
- 10 chamber where the cam plate acts on it.
24. A fuel-air mixture device as claimed in claim 23, wherein the needle is carried axially of the needle actuator and spring biased towards the primary air passage for closure of a fuel outlet orifice from the needle carrier to the primary air passage by engagement of a taper of the needle in the orifice.
- 15 25. A fuel-air mixture device as claimed in claim 24, wherein the needle carries an O-ring arranged to seal additionally the orifice with the needle.
26. A fuel-air mixture device as claimed in claim 23, claim 24 or claim 25, wherein the needle carrier has an extension in communication with the primary air passage and the extension has two outlets from the secondary air passage into the
- 20 extension.
27. A fuel-air mixture device as claimed in claim 26, wherein one of the outlets is from a slow running branch of the secondary air passage, having a slow running air flow adjustment and a second branch which is normally open, except when closed by a closure valve on closure of the throttle.
- 25 28. A fuel-air mixture device as claimed in claim 27, wherein the closure valve comprises a flat on a shaft of the throttle, which is arranged to open the branch when the throttle is open.

21. A fuel-air mixture device as claimed in any one of claims 15 to 20, wherein the passageway(s) have turbulence inducing formations downstream of the transverse bore(s), to aid mixture of the fuel with the air in the passageways.
22. A fuel-air mixture device as claimed in any preceding claim, including:
- 5 • a shaft on which the throttle is carried,
- a cam plate carried on a shaft and
- an actuator for the tapered needle bearing against the cam plate.
23. A fuel-air mixture device as claimed in claim 22, wherein the needle actuator is accommodated in a fuel tight manner in a needle carrier and extends into a lubricant
- 10 chamber where the cam plate acts on it.
24. A fuel-air mixture device as claimed in claim 23, wherein the needle is carried axially of the needle actuator and spring biased towards the primary air passage for closure of a fuel outlet orifice from the needle carrier to the primary air passage by engagement of a taper of the needle in the orifice.
- 15 25. A fuel-air mixture device as claimed in claim 24, wherein the needle carries an O-ring arranged to seal additionally the orifice with the needle.
26. A fuel-air mixture device as claimed in claim 23, claim 24 or claim 25, wherein the needle carrier has an extension in communication with the primary air passage and the extension has two outlets from the secondary air passage into the
- 20 extension.
27. A fuel-air mixture device as claimed in claim 26, wherein one of the outlets is from a slow running branch of the secondary air passage, having a slow running air flow adjustment and a second branch which is normally open, except when closed by a closure valve on closure of the throttle.
- 25 28. A fuel-air mixture device as claimed in claim 27, wherein the closure valve comprises a flat on a shaft of the throttle, which is arranged to open the branch when the throttle is open.

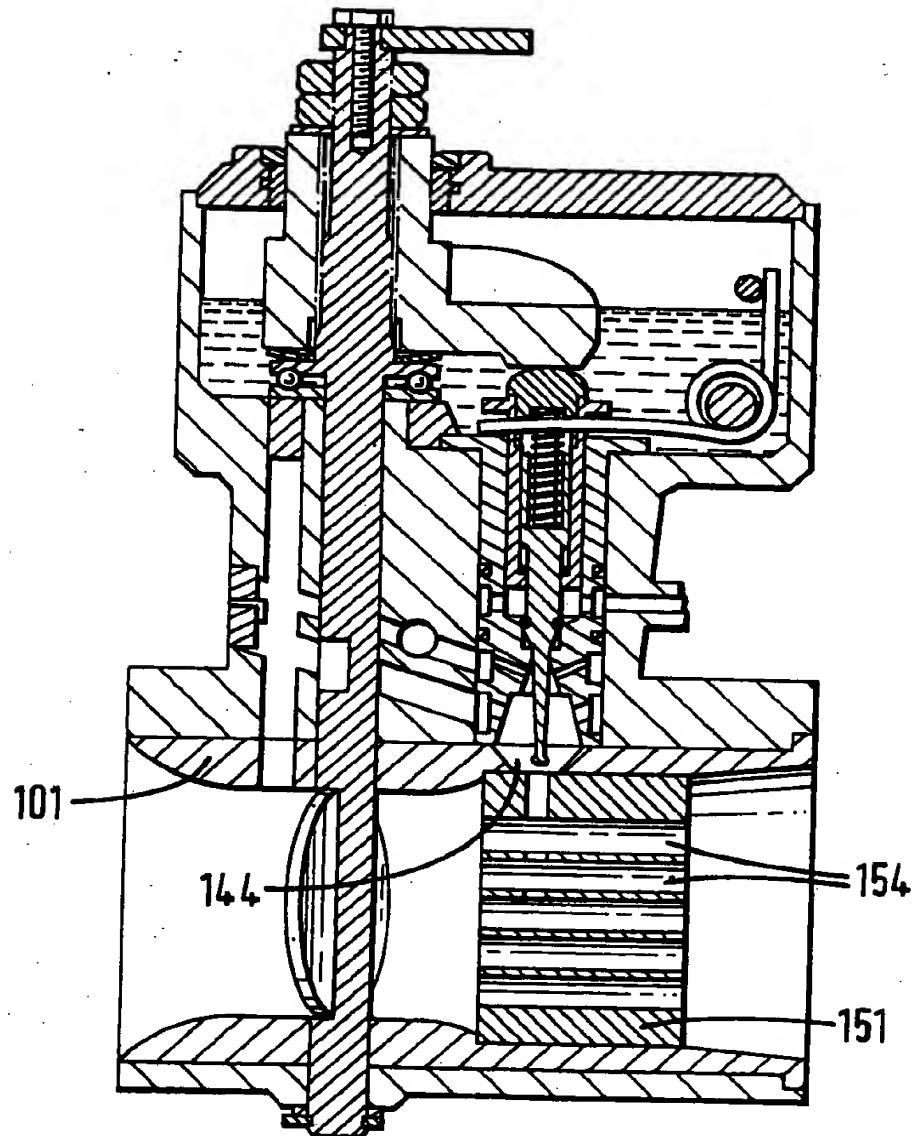
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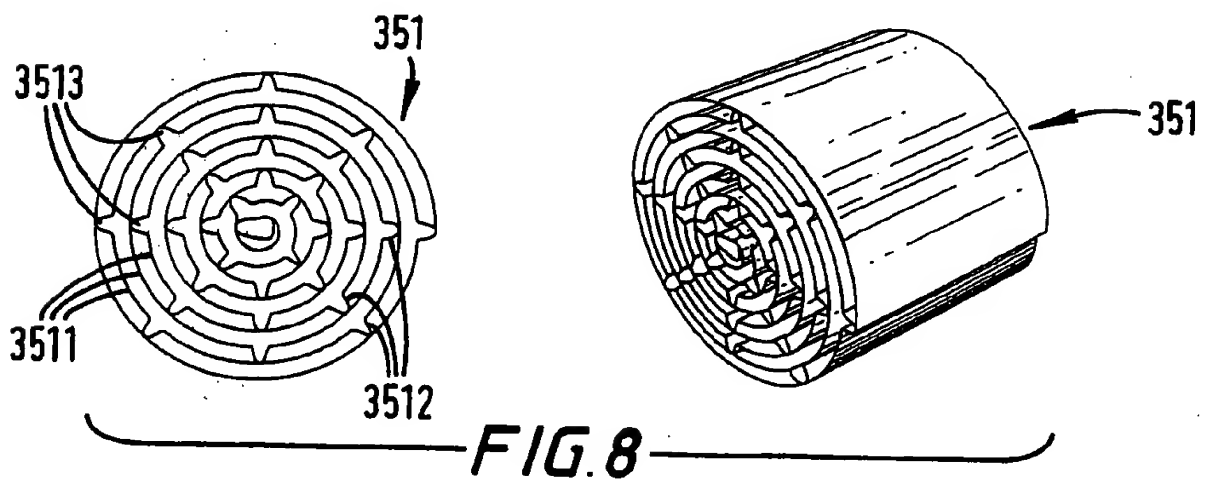
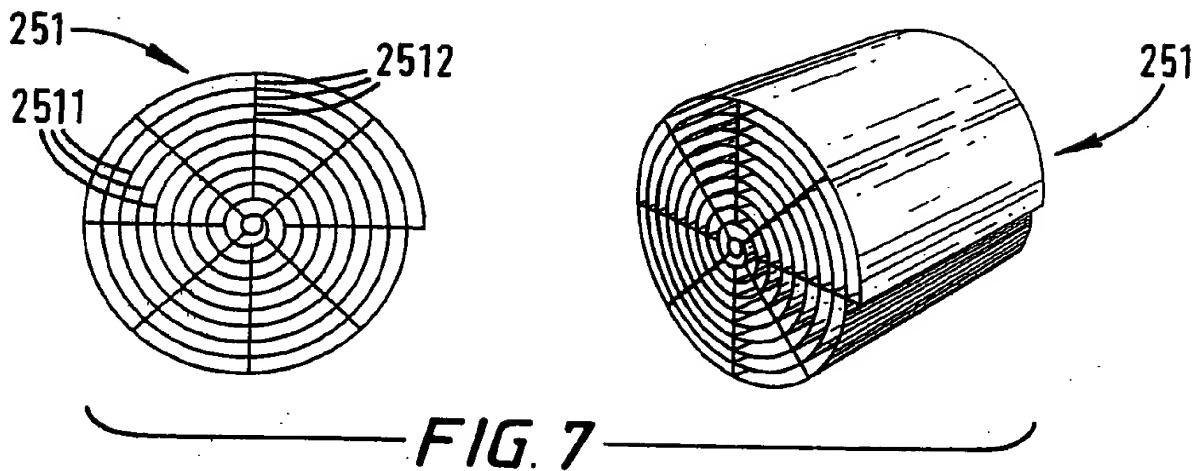
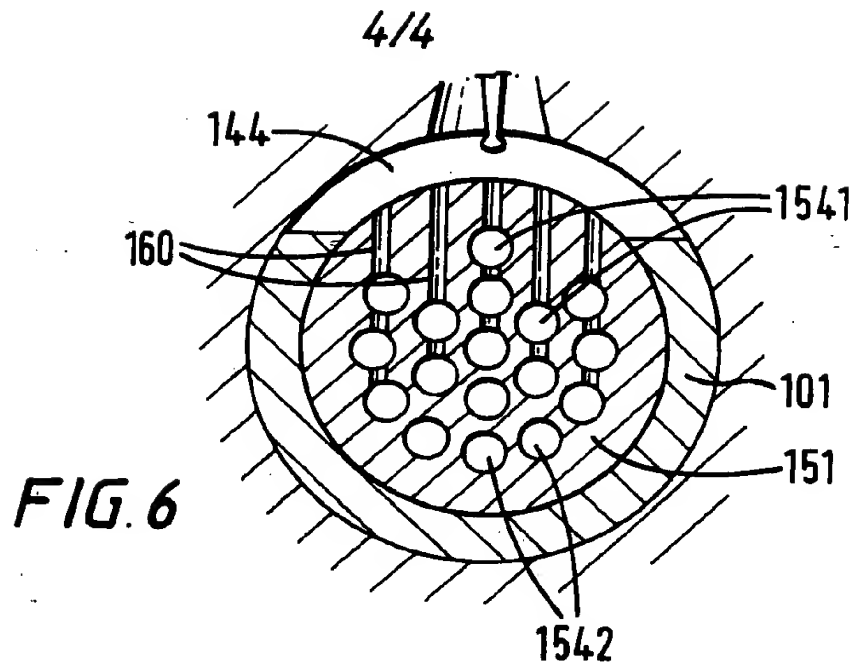
FIG. 1

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**FIG. 5**



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526 Rec'd PCT/PTO 28 DEC 2000

KRISTJAN BJORN OMARSSON C/O

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1515/PCT

5 July, 2000

European Patent Office
D-80298 Munchen
Germany

URGENT - RESPONSE TO WRITTEN OPINION DUE TODAY

Dear Sir,

Re: International Patent Application No. PCT/IB99/01214
Kristjan Bjorn OMARSSON

I write in reply to the Written Opinion of 5th April 2000, and enclose herewith amended claims.

The examiner asserts that Claim 1 lacks novelty in respect of US 3,814,391 - Cedarholm. This describes a carburettor having a needle arrangement which is clearly different from the arrangement of the present invention. As far as can be understood, the "needle" of the citation has a groove 35, which is exposed to a greater or lesser extent. The difference from the invention has NOW been stressed in claim 1 by clarifying that the needle is tapered, pointing towards the primary air passage and withdrawable to increase the orifice of the nozzle as the throttle is opened. For this reason alone the citation does not impugn the novelty of claim 1 at least as amended.

Cedarholm does have a series of passages 93, most of which have nothing to do with mixing the fuel with the air flowing in them, since the fuel is dispensed above the top passage and cannot reach the bulk of the passages. Therefore this citation teaches nothing about fuel/air mixing in an apertured vaporisation block.

In particular, in the words of claim 1, Cedarholm does not teach "sub-division of a portion of the primary air passage between the fuel introduction position and the outlet", because the fuel is introduced at 52 into the upper passageway 93, which is NOT further subdivided.

As a further clarification, the "portion" of the primary air passage which is sub-divided is NOW said to be "longitudinal" as opposed to transverse in the sense of the transverse orientation of the needle, to emphasise that the entire air flow passes through the divided portion. This is in contradistinction to the sort of arrangement of the passageways 97 of Cedarholm, which leave a large

up above the top fin 96, where the richest mixture is likely to be passing – corresponding to the introduction of the fuel at the top passageway 93.

In short, I submit that claim 1 is clearly novel with respect to Cedarholm.

In fact what Cedarholm really teaches is nothing to do with use of the passages for improving the mixture therein, but use of the passages to direct the air in a concentrated fashion against the fins 94 across which the fuel rich air is flowing. The result is a highly turbulent flow. This is not what is being achieved in the invention. As mentioned at line 30 on page 6 of the specification, it is believed that at least part of the benefit from the invention is achieved by providing the large surface area in the passageways for deposit and re-evaporation of fuel. This is advantageous in a single cylinder engine where the induction stroke results in fast air flow through the carburettor, followed by three strokes of stagnation. **Adoption of the Cedarholm design would produce no advantage of this nature at all.**

Aside from the above novelty considerations, claim 1 has NOW been amended to incorporate the features of claim 14, namely the secondary air passage of the inventor's earlier application, WO 97/48897 – referred to here as in the present application as "the Earlier Invention".

Cedarholm has – of course – no teaching whatsoever about use of a secondary air passage. However, the examiner objects that it is obvious to combine the Earlier Invention into the apparatus of Cedarholm. Always supposing this to be the case, i.e. that it is obvious to make the combination, which is denied, would the result be within the scope? The combination would result in using secondary air flow to introduce a better mixed fuel-air mixture into the top one of the passages 93. As pointed out above, this is not within the scope of claim 1 (as now incorporating the features of claim 14). The reason is that Cedarholm does NOT teach introducing the fuel not into the bulk of the passages 93.

Why would the man skilled in the art find it an obvious thing to do in the first place. Certainly at the date of the Earlier Invention, it was not obvious to the inventor, otherwise he would have done it. What is there in either document to suggest that a non-inventive improvement is going to be achieved by the combination? Neither suggests that it is not a complete solution for the problems that it was seeking to solve. Both are integral solutions in their own right.

The way the examiner has suggested that the combination would be made is that the skilled man starting from Cedarholm would note that the Earlier Invention has been employed for the purpose of improving fuel-air mixture apparatus and immediately think:

"I can incorporate this in a non-inventive way into Cedarholm and obtain an improvement". However, Cedarholm's structure is intended to provide a complete solution to the problem of a satisfactory mixture. The structure is a complex one providing a great deal of mixing of the fuel and air. So why completely re-engineer the product to incorporate another way of mixing, which as likely as not is going to be redundant in view of the effectiveness of Cedarholm. The Cedarholm arrangements for adjusting the fuel air mixture with throttle opening do not lend themselves to ready incorporation of the Earlier Invention, since the latter cannot utilise abument on the pointed end of the needle, which the skilled many would realise would be important to avoid.

In short combination of Cedarholm and the Earlier Invention is not a matter of simply bolting together a complementary pair of pieces of equipment – as one might put a new drill bit in a new electric drill. It is a fair more complex operation which would be beyond the capabilities of the man skilled in the art, who is imputedly all knowing, but of negligible other skill.

I have already pointed out that even if the combination were attempted, the result would not be within the scope of claim 1 as amended. Therefore, I submit that the correct conclusion is that claim 1 as NOW amended is inventive.

Further in respect of Cedarholm, the examiner objects that the features of claim 22 are shown in it. This is not the case, at least in respect of the normal accepted meaning of the word "cam". The following is a dictionary meaning taken from Microsoft Bookshelf 99, based on Chambers Dictionary:

cam¹ [*kam*], (*mechanics*)

noun an irregular projection on a revolving shaft or rotating cylinder, shaped so as to transmit regular movement to another part, eg to open the cylinder valves of a car engine.

cam'shaft or

cam'-wheel a shaft or wheel, bearing a cam or cams.

[Dutch *kam* cam or comb; cf **comb**, **kame**]¹

The lever 33 in Cedarholm although described as a "cam" is not one in the normal sense of the word. Cedarholm teaches the use of a lever which abuts against the end 36 of the metering valve 34 to provide a movement of the latter varying with the sine of the angle of the throttle shaft 30. A cam is carefully shaped to provide a desired movement, as in the cams of an internal combustion engine, as mentioned in the above dictionary meaning. Cedarholm does not teach this. To emphasise the structure being claimed by claim 22, now numbered 21, it has NOW been amended. Further a separate claim 28 has been introduced to the features of original claims 14 and 22.

Various other objections are raised against the subsidiary claims. Whilst these are not admitted, they are not relevant in that the subsidiary claims are appendant to a patentable main claim.

I look forward to receiving a favourable IPER in due course.

Yours faithfully

KRISTJAN BJORN OMARSSON

NB-1515pet-001-EPO-SJui00

¹The Chambers Dictionary. Copyright © 1994 by Chambers Harrap Publishers, Ltd. All rights reserved.

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/IB 99/01214	International filing date (day/month/year) 28/06/1999	(Earliest) Priority Date (day/month/year) 01/07/1998
Applicant OMARSSON KRISTJAN BJORN		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.
☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1
☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 99/01214

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 F02M29/04 F02M7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F02M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 814 391 A (CEDARHOLM O) 4 June 1974 (1974-06-04)	1-3, 8, 11, 13
Y	column 3, line 28 - line 55 column 5, line 34 - line 46; figures ---	4-6, 14-22
X	GB 452 377 A (R. ARNOLD) 20 August 1936 (1936-08-20) page 2, line 4 - line 23; figures ---	1, 2
X	DE 374 738 C (H. DRESCHER) 8 October 1923 (1923-10-08) page 1, line 24 - column 57; figure ---	1
Y	WO 97 48897 A (OMARSSON KRISTJAN BJOERN) 24 December 1997 (1997-12-24) page 6, line 25 - page 7, line 12; figures --- -/--	14-22

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

& document member of the same patent family

Date of the actual completion of the international search

23 September 1999

Date of mailing of the international search report

30/09/1999

Name and mailing address of the ISA

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Authorized officer

Alconchel y Ungria, J

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 99/01214

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 628 890 A (FREEMAN WINIFER W) 16 December 1986 (1986-12-16) column 1, line 10 - line 30 column 3, line 30 - line 34; figures ---	4-6
A	US 3 966 430 A (STEPHENS WOODROW W) 29 June 1976 (1976-06-29) abstract; figures ---	1
A	PATENT ABSTRACTS OF JAPAN vol. 096, no. 002, 29 February 1996 (1996-02-29) & JP 07 269866 A (MITSUBISHI HEAVY IND LTD), 20 October 1995 (1995-10-20) abstract ---	1
A	US 3 826 235 A (PASBRIG M) 30 July 1974 (1974-07-30) abstract; figures ---	1
A	WO 93 01406 A (REEFMAN FREDERIK MANNES) 21 January 1993 (1993-01-21) abstract; figures ---	1
A	WO 82 01746 A (BYERS EDWARD VICTOR) 27 May 1982 (1982-05-27) abstract; figures -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IB 99/01214

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3814391	A	04-06-1974	US 3857912 A	31-12-1974
GB 452377	A		NONE	
DE 374738	C		NONE	
WO 9748897	A	24-12-1997	AU 3045097 A	07-01-1998
			CA 2258246 A	24-12-1997
			EP 0906503 A	07-04-1999
			GB 2329935 A	07-04-1999
US 4628890	A	16-12-1986	NONE	
US 3966430	A	29-06-1976	NONE	
JP 07269866	A	20-10-1995	NONE	
US 3826235	A	30-07-1974	AT 367171 B	11-06-1982
			AT 988072 A	15-10-1981
			CA 962906 A	18-02-1975
			DE 2158849 A	07-06-1973
			FR 2165897 A	10-08-1973
			SE 379084 B	22-09-1975
WO 9301406	A	21-01-1993	NL 9101166 A	01-02-1993
			AU 2436592 A	11-02-1993
WO 8201746	A	27-05-1982	AU 7729981 A	07-06-1982
			EP 0064524 A	17-11-1982
			IT 1146716 B	19-11-1986

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

NIGEL BROOKS

13 OCT 2000

To:

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2-11-00
22-12-00
01-7-01

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing
(day/month/year)

10.10.2000

Applicant's or agent's file reference
1515/PCT

IMPORTANT NOTIFICATION

International application No.
PCT/IB99/01214

International filing date (day/month/year)
28/06/1999

Priority date (day/month/year)
01/07/1998

Applicant

OMARSSON KRISTJÁN BJÖRN

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/



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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference 1515/PCT	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IB99/01214	International filing date (day/month/year) 28/06/1999	Priority date (day/month/year) 01/07/1998
International Patent Classification (IPC) or national classification and IPC F02M29/04		
Applicant OMARSSON KRISTJÁN BJÖRN		

1. This International preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 7 sheets, including this cover sheet.
 - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 28/01/2000	Date of completion of this report 10.10.2000
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Godrie, P Telephone No. +49 89 2399 7349 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/IB99/01214

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-8 as originally filed

Claims, No.:

1-27 as received on 05/07/2000 with letter of 05/07/2000

Drawings, sheets:

1/4-4/4 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☒ the claims, Nos.: 28
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB99/01214

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-27
	No:	Claims	
Inventive step (IS)	Yes:	Claims	22,24-27
	No:	Claims	1-21, 23
Industrial applicability (IA)	Yes:	Claims	1-27
	No:	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/IB99/01214

Re Item V

1. Reference is made to the following documents:

D1= US-A-3 814 391
D2= WO 97 48897 A
D3= US-A-4 628 890
D4= US-A-3 826 235

2. Independent Claim

The document WO 97 48897 A (D2) is regarded as being the closest prior art to the subject-matter of claim 1, and shows in Fig. 1 a fuel-air mixture device comprising:

- a primary air passage having
 - an inlet,
 - an adjustable throttle and
 - an outlet,
 - a secondary air passage having
 - an inlet from the primary air passage between its inlet and its adjustable throttle and
 - an outlet to the primary air passage between its adjustable throttle and its outlet,
 - a variable orifice nozzle for introducing fuel to the primary air passage, the nozzle having
 - a mouth for dispensing fuel into the primary air passage upstream of its outlet and
 - a tapered needle in the mouth to provide variability of the orifice by axial movement of the needle, the needle being arranged transversely of the primary air passage with its small diameter end directed towards the primary air passage;
- the arrangement being such that in use the fuel mixes with the air flowing through the secondary air passage prior to mixing with the air flowing in the primary air passage,
- a linkage or control device for linking or controlling the position of the needle to the position of the adjustable throttle in the primary air passage for adjustment of the orifice of the nozzle.

The subject-matter of claim 1 therefore differs from this known fuel-air mixture device in that:

- it further comprises an apertured vaporisation block having a plurality of air

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/IB99/01214

passageways through the block, which subdivide a longitudinal portion of the primary air passage between the fuel introduction position and the outlet, the arrangement being such that the fuel, the air flowing through the secondary air passage and the air flowing through the primary air passage all pass through the air passageways for mixture of the fuel and the air

and

- the mechanism for controlling the position of the needle to the position of the adjustable throttle comprises:
 - a shaft on which the throttle is carried,
 - a cam plate carried on a shaft and
 - an actuator for the tapered needle bearing against the cam plate, the arrangement being such that as the throttle is opened, the needle is lifted from the mouth of the nozzle, and
 - the fuel flow from the nozzle is matched to the position of the adjustable throttle.

The problems to be solved by the present invention may therefore be regarded as

- a) the improvement of the homogeneity of the fuel-air mixture and
- b) an alternative mechanism for controlling the needle position to the throttle position.

The solution proposed in claim 1 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons.

The apertured vaporisation block is described in D4 as providing the same advantages (see column 2, lines 14-20) as in the present application. The skilled person would therefore regard it as a normal option to include this feature in the fuel-air mixture device described in D2 in order to solve the problem a) posed.

The mechanism with the cam plate for controlling the needle position to the throttle position is merely one of several straightforward possibilities (as shown in D1, Fig. 1) from which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill, in order to solve the problem b) posed.

As these solutions to problems a) and b) do not interact with each other, the skilled person would regard it a normal design procedure to combine all the features set out in claim 1. Thus, the subject-matter of this claim does not involve an inventive step and does not satisfy the criterion set forth in Article 33(3) PCT.

3. Dependent claims

Dependent claims 2-21, 23 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step, the reasons being as follows:

- 3.1 Claim 2
The spring for lifting the needle as described in claim 2 is merely one of several straightforward possibilities from which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill, in order to open the needle under the control of the cam plate.
- 3.2 Claims 3, 12-14
All the additional features of claims 3, 12-14 are already presented in D1, Fig. 1.
- 3.3 Claims 5 to 7
The additional features of these dependent claims have already been employed for the same purpose in a similar fuel-air mixture device, see document D3, column 3, lines 30-34.
- 3.4 Claim 8
The way to produce the air passageways described in claim 8 is a matter of a usual procedure. Its use for producing the aperture vaporisation block disclosed in D4 would therefore be an obvious possibility for the skilled person.
- 3.5 Claims 4, 9-11, 14, 21
All the additional features of claims 4, 14, 21 are already presented in D4, Fig. 1. The additional features of dependent claims 9-11 have already been employed for the same purpose in a similar fuel-air mixture device, see document D4, Fig. 3, column 5, lines 48-65. It would therefore be obvious to the person skilled in the art, to apply these features with corresponding effect to a fuel-air mixture device according to D2+D4, thereby arriving at a fuel-air mixture device according to these claims.
- 3.6 Claims 15 to 19
The additional features of these claims are disclosed in D1. A similar reasoning as in paragraph 3.3 would show that the subject-matter of these claims lacks also inventive step.

3.7 Claim 20

In claim 20 a slight constructional change in the fuel-air mixture device of claims 15 to 19 is defined which comes within the scope of the customary practice followed by persons skilled in the art, especially as the advantages thus achieved can readily be foreseen. Consequently, the subject-matter of claim 20 also lacks an inventive step.

3.8 Claim 23

All the additional features of this dependent claim have already been employed for the same purpose in a similar fuel-air mixture device, see document D2, Fig. 1. It would therefore be obvious to the person skilled in the art, to apply these features with corresponding effect to a fuel-air mixture device according to document D2+D4, thereby arriving at a fuel-air mixture device according to claim 23.

Claim 22 discloses a particular disposition of the needle actuator and carrier extending into a lubricant chamber. This is not presented in, nor rendered obvious from, any of the available prior art.

The sealing set-up claimed in claim 24 is not known from the prior art given in the international search report.

The features of the two air outlets coming from the secondary air passage as proposed in claims 25, 26 or 27 are not found in any available prior art. Additionally, it would not be obvious for the skilled man in the art to combine the features disclosed in the prior art such as to arrive to a subject-matter as presented in any of these claims

Re Item VII

The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Re Item VIII

Claims 5 to 7 do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claims attempt to define the subject-matter in terms of the result to be achieved ("ultrasonically excitable") which merely amounts to a statement of the underlying problem. The technical features necessary for achieving this result are not mentioned. Moreover, the description does not bring any support for these features.

Claims

1. A fuel-air mixture device comprising:

- a primary air passage having
 - an inlet,
 - an adjustable throttle and
 - an outlet,
 - a secondary air passage having
 - an inlet from the primary air passage between its inlet and its adjustable throttle and
 - an outlet to the primary air passage between its adjustable throttle and its outlet,
 - a variable orifice nozzle for introducing fuel to the primary air passage, the nozzle having
 - a mouth for dispensing fuel into the secondary air passage upstream of its outlet and
 - a tapered needle in the mouth to provide variability of the orifice by axial movement of the needle, the needle being arranged transversely of the primary air passage with its small diameter end directed towards the primary air passage,
- the arrangement being such that in use the fuel mixes with the air flowing through the secondary air passage prior to mixing with the air flowing in the primary air passage,
- a linkage or control device for linking or controlling the position of the needle to the position of the adjustable throttle in the primary air passage for adjustment of the orifice of the nozzle
 - an apertured vaporisation block having a plurality of air passageways through the block, which subdivide a longitudinal portion of the primary air passage between the fuel introduction position and the outlet, the arrangement being such that the fuel, the air flowing through the secondary air passage and the air flowing through the primary air passage all pass through the air passages for mixture of the fuel and the air and

a mechanism for controlling the position of the needle to the position of the adjustable throttle in the primary air passage for adjustment of the orifice of the nozzle, the mechanism comprising:

- a shaft on which the throttle is carried,
- a cam plate carried on a shaft and
- an actuator for the tapered needle bearing against the cam plate, the arrangement being such that as the throttle is opened, the needle is lifted from the mouth of the nozzle, and
- the fuel flow from the nozzle is matched to the position of the adjustable throttle.

2. A fuel-air mixture device as claimed in claim 1, including a spring for lifting the needle from the mouth of the nozzle, under control of the cam plate, as the throttle as opened.

3. A fuel-air mixture device as claimed in claim 1 or claim 2, wherein the apertured vaporisation block is integral with a member defining the primary air passage.

4. A fuel-air mixture device as claimed in claim 1 or claim 2, wherein the apertured vaporisation block is a member fitted to the primary air passage.

5. A fuel-air mixture device as claimed in claim 4, wherein the apertured vaporisation block is mounted in such manner as to be ultrasonically excitable.

6. A fuel-air mixture device as claimed in claim 5, wherein the apertured vaporisation block is mounted in an ultrasonically excitable ring.

7. A fuel-air mixture device as claimed in claim 5, wherein the passageways in the block are lined by ultrasonically excitable tubes.

8. A fuel-air mixture device as claimed in any preceding claim, wherein the apertured vaporisation block is a solid block in which the air passageways are formed by machining or casting.

9. A fuel-air mixture device as claimed in any one of claims 1 to 7, wherein the apertured vaporisation block is laid up from a plurality of layers, preferably by winding, the layers having regular formations extending out from each layer to space it from the next layer.

10. A fuel-air mixture device as claimed in claim 9, wherein the formations at each layer are continuous with the formations at the next.

11. A fuel-air mixture device as claimed in claim 9, wherein the formations at each layer are inter-spaced with the formations at the next.
12. A fuel-air mixture device as claimed in any preceding claim, wherein the apertured vaporisation block is provided wholly downstream of the position of the fuel introduction means.
13. A fuel-air mixture device as claimed in claim 12, wherein an upstream face of the apertured vaporisation block is concavely formed, preferably conically.
14. A fuel-air mixture device as claimed in any one claims 1 to 11, wherein the apertured vaporisation block is provided at and extending downstream of the position of the variable orifice nozzle.
15. A fuel-air mixture device as claimed in any preceding claim, wherein the apertured vaporisation block has at least one transverse bore leading from the secondary air passage to a respective one of the air passageways through the block.
16. A fuel-air mixture device as claimed in claim 15, wherein each of the passageways has a transverse bore leading from the secondary air passage.
17. A fuel-air mixture device as claimed in claim 15, wherein some of the air passageways are not in communication with the secondary air passage, whereby they do not receive fuel-air mixture in use.
18. A fuel-air mixture device as claimed in claim 15, claim 16 or claim 17, wherein some of the air passageways are in communication with the secondary air passage only via others of them.
19. A fuel-air mixture device as claimed in any one of claims 14 to 18, wherein the fuel introduction needle extends into one or more of the air passageways in the apertured vaporisation block.
20. A fuel-air mixture device as claimed in any one of claims 15 to 19, wherein the passageway(s) having the transverse bore(s) are configured as venturi(s) with the narrowest throat(s) being at the orifice(s) of the transverse bore.
21. A fuel-air mixture device as claimed in any one of claims 15 to 20, wherein the passageway(s) have turbulence inducing formations downstream of the transverse bore(s), to aid mixture of the fuel with the air in the passageways.
22. A fuel-air mixture device as claimed in any preceding claim, wherein the needle actuator is accommodated in a fuel tight manner in a needle carrier and extends into a lubricant chamber where the cam plate acts on it.

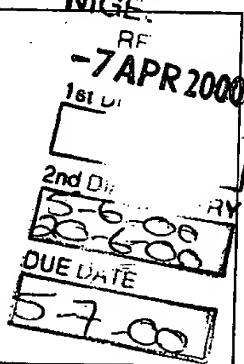
23. A fuel-air mixture device as claimed in claim 22, wherein the needle is carried axially of the needle actuator and spring biased towards the primary air passage for closure of a fuel outlet orifice from the needle carrier to the primary air passage by engagement of a taper of the needle in the orifice.
- 5 24. A fuel-air mixture device as claimed in claim 23, wherein the needle carries an O-ring arranged to seal additionally the orifice with the needle.
25. A fuel-air mixture device as claimed in claim 22, claim 23 or claim 24, wherein the needle carrier has an extension in communication with the primary air passage and the extension has two outlets from the secondary air passage into the
- 10 extension.
26. A fuel-air mixture device as claimed in claim 25, wherein one of the outlets is from a slow running branch of the secondary air passage, having a slow running air flow adjustment and a second branch which is normally open, except when closed by a closure valve on closure of the throttle.
- 15 27. A fuel-air mixture device as claimed in claim 26, wherein the closure valve comprises a flat on a shaft of the throttle, which is arranged to open the branch when the throttle is open.

PATENT COOPERATION TREATY

From the:

INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

OMARSSON, Kristján Björn
Nigel BROOKS
Hill Hampton
East Meon
Petersfield
Hampshire GU32 1QN
GRANDE BRETAGNE



PCT

WRITTEN OPINION

(PCT Rule 66)

Applicant's or agent's file reference 1515/PCT		Date of mailing (day/month/year) 05.04.2000
REPLY DUE within 3 month(s) from the above date of mailing		
International application No. PCT/IB99/01214	International filing date (day/month/year) 28/06/1999	Priority date (day/month/year) 01/07/1998
International Patent Classification (IPC) or both national classification and IPC F02M29/04		
Applicant OMARSSON KRISTJÁN BJÖRN		

1. This written opinion is the **first** drawn up by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain document cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

3. The applicant is hereby **invited to reply** to this opinion.


When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also: For an additional opportunity to submit amendments, see Rule 66.4.
For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 bis.
For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: **01/11/2000**.

Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer / Examiner Godrie, P Formalities officer (incl. extension of time limits) Staf, C Telephone No. +49 89 2399 2698
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I. Basis of the opinion

1. This opinion has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed"*):

Description, pages:

1-8 as originally filed

Claims, No.:

1-28 as originally filed

Drawings, sheets:

1/4-4/4 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-3,11-13,22
Inventive step (IS)	Claims	4-8,14-21,24
Industrial applicability (IA)	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1= US-A-3 814 391

D2= WO 97 48897 A

D3= US-A-4 628 890

D4= US-A-3 826 235

2. **Novelty**

2.1 Claim 1

The document D1 discloses in Fig. 1 (the references applying to this document) a fuel-air mixture device comprising:

- a primary air passage having an inlet 16, an adjustable throttle 31 and an outlet,
- a variable orifice nozzle for introducing fuel to the primary air passage, the nozzle having a mouth and a tapered needle 34 in the mouth to provide variability of the orifice by axial movement of the needle 34, the needle 34 being arranged transversely of the primary air passage and
- a linkage or control device for linking or controlling the position of the needle 34 to the position of the adjustable throttle 31 in the primary air passage for adjustment of the orifice of the nozzle and
- an aperture vaporisation block having a plurality of air passageways 93,97 through the block, which subdivide a portion of the primary air passage between the fuel introduction position and the outlet.

The subject-matter of claim 1 is therefore not new (Article 33(2) PCT).

2.2 Claims 2, 3, 11 to 13, and 22

These dependent claims do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty, as all the additional features of these claims are also presented in D1, Fig. 1.

3. Inventive step

3.1 Claims 4 to 6

The additional features of these dependent claims have already been employed for the same purpose in a similar fuel-air mixture device, see document D3, column 3, lines 30-34. It would therefore be obvious to the person skilled in the art, to apply these features with corresponding effect to a fuel-air mixture device according to D1, thereby arriving at a fuel-air mixture device according to claim 4, 5 or 6.

3.2 Claim 7

The way to produce the air passageways described in claim 7 is a matter of a usual procedure. Its use for producing the aperture vaporisation block disclosed in D1 would therefore be an obvious possibility for the skilled person.

3.3 Claim 8

The additional features of dependent claim 8 have already been employed for the same purpose in a similar fuel-air mixture device, see document D4, Fig. 3, column 5, lines 48-65. It would therefore be obvious to the person skilled in the art, to apply these features with corresponding effect to a fuel-air mixture device according to D1, thereby arriving at a fuel-air mixture device according to claim 8.

3.4 Claims 14 and 24

All the additional features of these dependent claims have already been employed for the same purpose in a similar fuel-air mixture device, see document D2, Fig. 1. It would therefore be obvious to the person skilled in the art, to apply these features with corresponding effect to a fuel-air mixture device according to document D1, thereby arriving at a fuel-air mixture device according to claim 14 or 24.

3.5 Claims 15 to 19 and 21

The additional features of these claims are disclosed in D1. A similar reasoning as in paragraph 3.2 would show that the subject-matter of these claims lacks also inventive step.

3.6 Claim 20

In claim 20 a slight constructional change in the fuel-air mixture device of claims

15 to 19 is defined which comes within the scope of the customary practice followed by persons skilled in the art, especially as the advantages thus achieved can readily be foreseen. Consequently, the subject-matter of claim 20 also lacks an inventive step.

4. The combination of the features of dependent claim 23, 25, 26, 27 or 28 is neither known from, nor rendered obvious by, the available prior art. It is suggested therefore that a new independent claim be drafted to include these features, bearing in mind that the features known in combination in D1 should be placed in the preamble of such a claim in accordance with Rule 6.3(b) PCT.

Re Item VII

Certain defects in the international application

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.

The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Re Item VIII

Certain observations on the international application

Claims 4 to 6 do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claims attempt to define the subject-matter in terms of the result to be achieved ("ultrasonically excitable") which merely amounts to a statement of the underlying problem. The technical features necessary for achieving this result should be added. Moreover, the description does not bring any support for these features.

The terms used in claims 9 and 10 to describe "the formations" are vague and unclear and leave the reader in doubt as to the meaning of the technical features to which they refer, thereby rendering the definition of the subject-matter of said claims unclear (Article 6 PCT).



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Correspondence with the EPO on PCT Chapter II demands

In order to ensure that your PCT Chapter II demand is dealt with as promptly as possible you are requested to use the enclosed self-adhesive labels with any correspondence relating to the demand sent to the Munich Office.

One of these labels should be affixed to a prominent place in the upper part of the letter or form etc. which you are filing.

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C. 20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 22 March 2000 (22.03.00)	
International application No. PCT/IB99/01214	Applicant's or agent's file reference
International filing date (day/month/year) 28 June 1999 (28.06.99)	Priority date (day/month/year) 01 July 1998 (01.07.98)
Applicant ÓMARSSON, Kristján, Bjőrn	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

28 January 2000 (28.01.00)

☐ in a notice effecting later election filed with the International Bureau on:2. The election ☒ was☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Pascal Piriou

Telephone No.: (41-22) 338.83.38

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